

What is claimed is:

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1. A system for treating bone fractures, the system comprising:
an intramedullary nail defining an opening, said opening having an upper surface and
a lower surface;
a transverse member including a bone engaging portion and a connection portion, said
connection portion defining a thru-hole, said nail being sized to pass through said thru-hole;
and
10 a pin selectively attached to said transverse member and operable to rigidly assemble
said transverse member to said nail when said nail passes through said thru-hole and said pin
is received within said opening.
- 15 2. The system of claim 1 wherein said transverse member defines a passage
intersecting said through-hole.
- 20 3. The system of claim 2 wherein said passage includes a threaded portion, said
pin includes a leading portion and a trailing portion, said leading portion has an elongated
section configured to be slidably received within said opening, said trailing portion has
external threads to engage said threaded portion to advance said pin through said passage.
4. The system of claim 1 wherein said pin includes an engaging surface
configured to engage said nail and clamp said nail against said transverse member.

5. The system of claim 1 wherein said pin includes a leading portion and a trailing portion, one of said leading portion and said trailing portion includes a ball member and another of said leading portion and said trailing portion includes a socket member, said ball and socket members cooperating to permit angular variation between said leading portion
5 and said trailing portion.

6. The system of claim 5 wherein said nail defines a first longitudinal axis and said opening defines a generally straight pathway positioned at about 135 degrees relative to said first longitudinal axis, said transverse member defines a second longitudinal axis and
10 said through-hole is positioned within a range of about 130 to 145 degrees relative to said second longitudinal axis.

7. The system of claim 1 wherein said connection portion is adapted to slidably receive said bone engaging portion.
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8. The system of claim 7 wherein said bone engaging portion includes a keeper, said connection portion includes an inner retaining lip, said keeper co-acting with said retaining lip to provisionally maintain said bone engaging portion and said connection portion in sliding engagement.
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9. The system of claim 1 further comprising a locking mechanism positioned adjacent said pin to prevent movement of said pin relative to said transverse member.

10. The system of claim 1 wherein said nail defines a longitudinal axis and includes a longitudinal passageway extending at least partially therethrough and intersecting said opening, a portion of said longitudinal passageway being threaded to engage a set screw, said set screw including a stem portion adapted to be slidably received within said longitudinal passageway to lockingly engage said pin.

11. The system of claim 1 wherein said nail defines a longitudinal axis, said lower surface of said opening defines a first angled portion to engage said pin in an abutting relationship with said pin oriented at a first oblique angle relative to said longitudinal axis.

12. The system of claim 11 wherein said upper surface of said opening defines a second angled portion generally opposite said first angled portion to engage said pin when said pin is oriented at said first oblique angle.

13. The system of claim 12 wherein said lower surface defines a third angled portion to engage said pin in another abutting relationship with said pin oriented at a second oblique angle relative to said longitudinal axis.

14. The system of claim 13 wherein said upper surface defines a fourth angled portion generally opposite said third angled portion to engage said pin when said pin is oriented at said second oblique angle.

15. The system of claim 14 wherein said first and second oblique angles are each about 135 degrees.

16. The system of claim 14 wherein said opening extends through said nail, and wherein said first and third angled portions define a first apex and said second and fourth angled portions define a second apex opposite said first apex.

5 17. A device for treating bone fractures, the device comprising:
an intramedullary nail defining an opening, said opening having an upper surface and a lower surface;

10 a transverse member including means for engaging bone, said transverse member defining a thru-hole, said nail being sized to pass through said thru-hole; and
means for locking said transverse member in position relative to said nail, said locking means including a pin sized to pass through said opening and rigidly assemble said transverse member to said nail.

15 18. The device of claim 17 wherein said transverse member defines a longitudinal axis and includes means for permitting free movement of said engaging means along said longitudinal axis of said transverse member.

20 19. The device of claim 18 wherein said transverse member includes means for provisionally maintaining said engaging means and said transverse member in sliding engagement.

20. The device of claim 17 wherein said locking means includes a means for allowing angular variation between said locking means and said transverse member.

21. The system of claim 17 wherein said opening extends through said nail.

22. A method of treating a bone fracture, the method comprising:

5 forming a first hole in a femur transverse to the medullary canal;

introducing a transverse bone engaging member through the first hole, the bone engaging member including a thru-hole, the thru-hole being positioned adjacent the medullary canal;

forming a second hole into the medullary canal;

10 inserting an intramedullary nail into the medullary canal through the second hole, the nail passing through the thru-hole of the bone engaging member, the nail including an opening positioned adjacent the bone engaging member, the opening having an upper surface and a lower surface; and

rigidly assembling the bone engaging member and the nail by passing a pin

15 selectively coupled to the bone engaging member into the opening of the nail.

23. The method of claim 22 including adjusting the angular position of the pin relative to the bone engaging member.

20 24. The method of claim 22 wherein the assembling includes threading the pin into a passage defined by the bone engaging member, the passage intersecting the thru-hole.

25. The method of claim 22 wherein the upper and lower surfaces are angled to define a first apex opposite a second apex.

26. The method of claim 22 wherein the introducing includes threading at least a portion of the bone engaging member into bone.

5 27. A system for treating bone fractures, the system comprising:
an intramedullary nail having a first end portion opposite a second end portion along a longitudinal axis, said first end portion including an opening extending through said nail and having a first angled surface aligned at a first oblique angle relative to said longitudinal axis;
a sleeve configured to fit over said first end portion of said nail, said sleeve including
10 a set of apertures positioned on opposite sides of said sleeve, said set of apertures and said opening aligned to form a first passageway bounded on one side by said first angled surface when said sleeve is fitted over said first end portion; and
a bone engaging member configured to be slidably received within said first
passageway, said bone engaging member establishing an abutting relationship with said first
15 angled surface when positioned within said first passageway.

28. The system of claim 27 wherein said opening has a second angled surface generally opposite said first angled surface to engage said bone engaging member, said first and second angled surfaces cooperating to define a first pathway oriented at said first oblique
20 angle for said bone engaging member to follow when received in said first passageway.

29. The system of claim 28 wherein said opening has a third angled surface aligned at a second oblique angle relative to said longitudinal axis to engage said bone engaging member in another abutting relationship when said sleeve is aligned in another

position to define a second passageway, and said bone engaging member is positioned within said second passageway.

30. The system of claim 29 wherein said opening has a fourth angled surface
5 generally opposite said third angled surface to engage said bone engaging member, said third and fourth angled surfaces cooperating to define a second pathway oriented at said second oblique angle for said bone engaging member to follow when received in said second passageway.

10 31. The system of claim 30 wherein said first and second oblique angles are each about 135 degrees.

32. The system of claim 30 wherein said opening extends through said nail and
15 wherein said first and third angled surfaces define a first apex and said second and fourth angled surfaces define a second apex opposite said first apex.

33. A bone fracture treatment apparatus comprising:
an elongated intramedullary nail having a longitudinal axis and a transverse axis
generally perpendicular to the longitudinal axis, said nail defining a transverse opening
20 therethrough, said opening extending along the transverse axis from a first side of said nail to an opposite second side of said nail, said opening being bounded by an upper surface and an opposite lower surface, one of said upper and lower surfaces defining a first projection
between said first side and said second side, said first projection extending in a longitudinal
direction to narrow a dimension of said opening along the longitudinal axis.

34. The apparatus of claim 33, further comprising a sleeve with first and second apertures positioned on opposite sides of said sleeve and configured to align with said opening to form a passageway, said passageway following a pathway from one of said apertures to the other of said apertures, said pathway being oriented at an oblique angle to the longitudinal axis.

35. The apparatus of claim 34, further comprising a bone engaging member sized to pass through said passageway and contact said first projection when positioned in said passageway.

36. The apparatus of claim 34 wherein said nail includes a transverse passage extending at least partially therethrough and configured to accept a fastener, said sleeve includes a third aperture configured to align with said transverse passage, said fastener releasably securing said sleeve to said nail when said fastener is positioned through said third aperture and into said transverse passage.

37. The system of claim 36 wherein said nail includes a longitudinal passage extending therethrough, and wherein said fastener has a length which does not extend into said longitudinal passage when said sleeve is releasably secured to said nail.

38. The system of claim 33 wherein said first projection defines an apex.

39. The system of claim 33 wherein the other of said one of said upper and lower surfaces defines a second projection between said first side and said second side, said second projection extending in a longitudinal direction and positioned generally opposite said first projection to further narrow a dimension of said opening along the longitudinal axis.

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40. The system of claim 39 wherein said second projection defines an apex.

41. A system for treating bone fractures, the system comprising:

an intramedullary nail defining a longitudinal axis and a transverse axis generally perpendicular to the longitudinal axis, said nail defining an opening therethrough along the transverse axis, said opening being bounded by a bearing surface;

a sleeve defining a pair of apertures on opposite sides of said sleeve, each of said apertures defining an engaging surface, said apertures and said opening aligned to form a passageway when said sleeve is fitted over said nail;

a bone engaging member sized to pass through said passageway; and

means for biasing said sleeve in a longitudinal direction to firmly engage said engaging surface of at least one of said apertures against said bone engaging member and clamp said bone engaging member to said bearing surface of said opening.

42. The system of claim 41 wherein at least one of said nail and said sleeve define an internally threaded portion, said biasing means includes an end cap, said end cap defining external threads to engage said internally threaded portion of said one of said nail and said sleeve to thereby bias said sleeve in a longitudinal direction.

43. The system of claim 42 wherein said nail and said sleeve each define an internally threaded portion, said end cap including a threaded end portion, a threaded intermediate portion and an enlarged end portion, and wherein said threaded end portion engages said internally threaded portion of said nail and said threaded intermediate portion engages said internally threaded portion of said sleeve to thereby bias said sleeve in a longitudinal direction.

44. The system of claim 42 wherein said end cap includes a hex broach to receive a driving tool.

45. A system for treating bone fractures, the system comprising:
an intramedullary nail defining a longitudinal axis, said nail defining an elongated, longitudinal opening laterally extending therethrough, and a longitudinal passage intersecting said opening;
a bone engaging member sized to pass through said opening; and
a positioning device disposed in said passage, the position of said device being adjustable along the longitudinal axis of said nail to move said bone engaging member passing through said slot and compress or distract said bone fracture.

46. The system of claim 45 wherein said positioning device includes a first portion and a second portion, said first portion being configured to rotate to adjust the position of said second portion along the longitudinal axis of said nail, said second portion being configured to move in correspondence with the rotation of said first portion and bear against said bone engaging member.

47. The system of claim 46 wherein said first portion includes a first threaded portion, said second portion including a second threaded portion, and wherein said second portion is transferred along the longitudinal axis of said nail as said first portion threadedly engages said second portion.

48. The system of claim 46 wherein said nail defines a threaded wall about said longitudinal passage, said first portion including a threaded portion to engage said threaded wall, and wherein said second portion is transferred along the longitudinal axis of said nail as said threaded portion threadedly engages said threaded wall and said first portion engages said second portion.